

Abdominal Wall

- 1.) Make a midline incision from the xiphisternum to the symphysis pubis, and reflect skin flaps laterally. Identify anterior and lateral cutaneous branches of the last 6 thoracic spinal nerves. Identify the terminal branches of the first lumbar spinal nerve (Iliohypogastric and ilioinguinal nerves in the iliac region).
 - 2.) Within the superficial fascia of the lower part of the anterior abdominal wall there is a membranous layer-Scarpa's fascia. This fascia fuses with the inguinal ligament, but medial to the pubic tubercle, a finger deep to this fascia can pass over the body of the pubis into the scrotum or labium majora - note that this is the course taken by the spermatic cord or round ligament.
 - 3.) Extend the midline incision around the genital region and for a short distance down the medial thigh before turning laterally so that the skin can be reflected from the region below the inguinal ligament. Identify superficial veins (superficial circumflex iliac, external pudendal and superficial epigastric, which join the great saphenous vein) and lymph nodes of the inguinal region. The great saphenous vein, lymph vessels pierce the fascia lata of the thigh at the saphenous hiatus (see also Zuckerman pp 2.20 to 2.21).
 - 4.) Clean the surface of the external oblique and the rectus sheath. Where possible retain superficial nerves and veins. Identify the origin of the external oblique muscle (which ribs?), note where it becomes aponeurotic, and find the spermatic cord or round ligament emerging from the superficial inguinal ring.
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- 1.) Detach the external oblique muscle from its attachment to the ribs, and reflect it downwards (inferiorly) and medially. Note the fibre direction of the underlying internal oblique muscle.
 - 2.) Cut internal oblique from its attachments to the ribs and continue this with a vertical incision in the midaxillary line. Reflect this muscle medially to reveal the neurovascular plane (ventral rami T7 to L1, with accompanying vessels), and the transversus abdominus muscle.
 - 3.) Cut transversus abdominus as for internal oblique and reflect it (together with the transversalis fascia) medially. This will expose a layer of extraperitoneal fatty tissue.

In thin subjects this layer may be absent and the peritoneum will be adherent to the transversus abdominus.

- 4.) Note how the three flat muscles fuse at the lateral margin of the rectus sheath. Open the rectus sheath with a vertical incision along the middle of the muscle, and reflect the anterior wall medially and laterally. Identify the pyramidalis muscle in front of the lower part of rectus abdominus. Detach the rectus abdominus muscle from the ribs and reflect it downwards to expose the superior and inferior epigastric vessels anastomosing behind the muscle. Note also branches from T7 to T12 supplying the rectus abdominus, and the differing constituents of the posterior wall of the rectus sheath. What is the arcuate line?
- 5.) The inguinal canal can be dissected in the way described in Zuckerman, or an incision can be made 5cm above and parallel to the inguinal ligament. Then the layers of the abdominal wall can be reflected downwards so their relationship to the inguinal canal can be examined. Identify the deep and superficial inguinal rings, the muscle fibres of the internal oblique and transversus abdominus, becoming tendinous and inserting as the conjoint tendon into the pubic crest, directly behind the superficial inguinal ring.
- 6.) In the male, the spermatic cord can be followed to the testis, and the testis can be lifted out of the scrotum. Tease out the layers of the spermatic cord and contents, and relate these to the layers of the abdominal wall.
- 7.) On the testis, open the tunica vaginalis and identify the epididymal sinus, and the head body and tail of the epididymis. Cut through part of the testis and tease out some seminiferous tubules (best seen if done in a bowl of water).

Abdominal Contents *in situ*

1. Make a midline and a transverse incision through what remains of the anterior abdominal wall, and fold the 4 flaps outwards. On the posterior aspect of the anterior abdominal wall identify the folds radiating from the umbilicus (ligamentum teres in the falciform ligament passing superiorly to the liver, and three folds passing inferiorly 1 median, and

2 medial umbilical ligaments - Gray's & Grant's texts). (Some texts, including Zuckerman & Cunningham, call these median and lateral umbilical ligaments).

2. **It is important, at this stage not to cut or damage any abdominal structures.** Spend the remainder of this lab exploring the peritoneal cavity and locating the abdominal organs, *in situ*. Identify the following organs and peritoneal folds, and explore the compartments, recesses and spaces of the peritoneal cavity with your gloved hand.
3. Locate the greater omentum arising from the greater curvature of the stomach. Lift it up (it may have some adhesions which you will need to loosen) and note that the transverse colon is attached to the posterior surface. The transverse colon and greater omentum subdivide the abdominal cavity into supracolic and infracolic compartments.
4. In the supracolic compartment you should see the liver and stomach, connected by the lesser omentum. The falciform ligament attaches the liver to the anterior abdominal wall and divides the space between the liver and the diaphragm into left and right subphrenic spaces.
5. Inferior to the liver, the fundus of the gall bladder can be seen. To the right of the gall bladder your hand can reach into a space between the liver and the right kidney (hepatorenal pouch).
6. Behind the gall bladder you will find that the lesser omentum has a right free edge. Grasp this free edge between the finger and thumb and you can feel the hepatic pedicle (common bile duct, portal vein and hepatic artery). Your finger, behind the hepatic pedicle will be in the epiploic foramen which leads into the lesser sac (omental bursa) of peritoneum behind the stomach.
7. On the left hand side, reach down between the body wall and the stomach and feel the spleen. The spleen is suspended in the dorsal mesentery of the stomach by two peritoneal folds - the gastrosplenic ligament and the lienorenal ligament. Superior to the spleen, the stomach is connected directly to the posterior wall by the gastrophrenic ligament. These ligaments help to enclose the lesser sac.
8. Turn the greater omentum up and explore the infracolic compartment of the greater sac. Follow the coils of small intestine from the last part of the duodenum (upper left) to the

caecum (lower right). The attachment of the mesentery runs between these points, and the small intestine can be folded to the left or right revealing the medial paracolic gutters.

9. Laterally the ascending and descending colon are (secondarily) retroperitoneal and they form spaces between the colon and the lateral body wall (lateral paracolic gutters)
10. Open the lesser sac by cutting the greater omentum 5cm from the greater curvature of the stomach. Explore the lesser sac with your hand

Blood supply of the digestive organs

This week's work is primarily tracing the branches of the coeliac, superior and inferior mesenteric arteries as they supply the foregut, midgut and hindgut. The dissection involves peeling the peritoneum from the mesenteries to follow the vessels. **THIS WILL NOT REQUIRE A SCALPEL!**

1. Begin by peeling the peritoneum from the lesser omentum to expose the left and gastric arteries (plus oesophageal and occasional hepatic branches). It may be necessary to remove the left lobe of the liver to get a full exposure of the lesser omentum. Follow the left gastric artery to the posterior wall and thence to the coeliac trunk. Follow the right gastric artery back to the common hepatic artery and to the coeliac trunk.
2. From the coeliac trunk you will also find the splenic artery going towards the left, partially hidden by the pancreas.
3. Peel the peritoneum from the greater omentum to expose the gastroepiploic vessels. Trace the right gastroepiploic artery to its parent, the gastroduodenal artery. Trace the left gastroduodenal artery into the gastrosplenic ligament, where it arises from the splenic artery. Also in the gastro splenic ligament look for short gastric branches of the splenic artery.
4. Return to the coeliac trunk and trace the common hepatic artery and its branches (gastroduodenal, right gastric and proper hepatic).. The proper hepatic artery may be followed to its left and right hepatic, and cystic branches.
5. The superior mesenteric artery arises from the aorta about 1cm inferior to the coeliac trunk. At this stage it is difficult to follow it from its origin without damaging the

pancreas. Fold the great omentum upwards to expose the transverse mesocolon, and begin peeling the off peritoneum to expose the middle colic artery.

6. You can follow the middle colic artery distally to the marginal artery which runs parallel with the colon, and proximally to the superior mesenteric artery on the posterior abdominal wall.
7. The superior mesenteric artery runs in the root of the mesentery and gives off many jejunal; and ileal branches into the mesentery from its left hand side. From the right side of the superior mesenteric artery arise the right colic and iliocolic arteries, trace these to the marginal artery on the ascending colon.
8. Push the small intestine to the right to expose the lower part of the aorta and the descending colon. Peel the peritoneum from the posterior abdominal wall in this region to expose branches of the inferior mesenteric artery. Trace the left colic artery to the marginal artery on the descending colon. Follow the inferior mesenteric artery inferiorly and identify its sigmoidal and superior rectal (haemorrhoidal) branches

Portal vein, biliary system, duodenum, pancreas & spleen

(The boxed sections can be done at any stage this week - be sure you understand the relations of the organs you remove. The unboxed sections are the real work for this week)

1. Complete your study of the arterial supply to the foregut, midgut and hindgut.
2. At this stage you can remove the jejunum and ileum by ligating and dividing each end, and cutting the root of the mesentery. Cut a small section of ileum and jejunum and examine their mucosa with a magnifying glass.
3. You may want to remove the large intestine as well, but be sure you have clear idea of its relations and attachments, - Double ligate & divide the sigmoid colon, and cut the blood supply to the colon so the marginal artery remains with the colon, but there are still sizeable stumps of the colic vessels to allow later recognition. Cut and wash a small

section of colon and examine its mucosa with a magnifying glass. Be sure you understand the cause and significance of the sacculations.

4. Cut through the pylorus of the stomach and open the body of the stomach by cutting in front of the greater curvature. Cut off a small piece of stomach wall, and examine the muscle coats and mucosa with a magnifying glass.
5. Trace the superior mesenteric, inferior mesenteric and splenic veins to the formation of the portal vein. Follow the portal vein through the head of the pancreas and free edge of the lesser omentum to the hilum of the liver. Compare the course of the superior mesenteric vein with that of the portal vein.
6. Clean and follow the other structures in the lesser omentum. Look for parts of the biliary system (cystic, left, right & common hepatic, and common bile ducts) and the branches of the hepatic artery (cystic, & left & right hepatic arteries). Does this liver have an accessory left hepatic artery? Is the hepatic artery from the coeliac or superior mesenteric artery?
7. Break the peritoneal reflection on the right side of the duodenum, and turn the second part of the duodenum to the left. You may want to remove the liver first (see below), but be sure you have studied the structures in the lesser omentum and hilum of the liver. Follow the common bile duct to the duodenum. Carefully remove some pancreatic tissue to expose and follow the pancreatic duct(s). Open the duodenum by cutting along its right side and look for the duodenal papillae, plicae and submucosal glands.
8. Remove the liver by:
 - a) Breaking/cutting the peritoneal connections to the diaphragm (Falciform, anterior and posterior coronary, and triangular ligaments),
 - b) Dividing the structures in the lesser omentum, and
 - c) Now the liver is only connected by the hepatic veins passing into the inferior vena cava. These may be torn off by sliding your fingers towards the remaining connections (occasionally, the right and caudate lobes of the liver encircle the IVC, in which case part of the IVC will come away with the liver).

9. Study the peritoneal reflections surrounding the bare area on the detached liver's diaphragmatic surface. On the visceral surface identify the lobes, fissures and grooves. Look at how the lesser omentum attaches to the liver, and follow the cystic and hepatic ducts and arteries. Cut off a piece of liver and examine it with a magnifying glass. Place the liver back in the abdominal cavity and consider the relations of the visceral surface (oesophageal, gastric, duodenal, renal, suprarenal, colic, epiploic, lesser sac).
10. Break the peritoneal fold on the left of the lienorenal ligament, and reflect spleen (together with the splenic artery and tail of the pancreas) to the right as far as the coeliac trunk.
11. Make sure you can replace the spleen in its correct orientation and that you know the colic, gastric renal and pancreatic parts of the visceral surface. Cut out a small wedge of spleen and study it with a magnifying glass.
12. Identify the parts of the pancreas. Can you see which parts were derived from dorsal and ventral pancreas? You can trace the pancreatic ducts by removing glandular tissue from the posterior surface. Can you find any posterior pancreaticoduodenal arteries on the posterior surface of the pancreas and duodenum? What organs and spaces form the relations of the pancreas?

Kidneys and posterior abdominal wall

Complete your study of the posterior abdominal wall:

- a. Examine the diaphragm, and the structures which pass through it.
 - b. Find the branches of the lumbosacral plexus, then remove one psoas to reveal the plexus itself, sympathetic rami and lumbar vessels.
 - c. Examine the pelvic peritoneum and the structures crossing the pelvic brim.
 - d. Examine the hypogastric plexus and its connections with abdominal autonomies.
1. Remove the pad of fat from around the kidney, but be careful not to damage the suprarenal glands, or their neural or vascular connections on the medial aspect. Mobilise the kidney and remove the fat which lies behind it on the posterior abdominal wall. Clean and identify the structures in the hilum of the kidney. Usually the veins lie in front of

the arteries and the ureters are posterior to both. Locate the gonadal and suprarenal veins and compare their connections with the renal vein on the left and right sides.

Find the ureter emerging from the renal pelvis, trace it and the gonadal vein down the posterior abdominal wall to the pelvic brim or deep inguinal ring.

Study the coeliac and superior mesenteric plexuses and look for a ganglion beside the stem of these arteries. Trace some of the numerous branches to the adrenal gland. Try to follow the posterior vagal trunk from the oesophageal hiatus to the coeliac plexus. Look for the greater splanchnic nerves piercing the crura of the diaphragm.

Study the paired branches of the aorta (inferior phrenic, suprarenal, renal, gonadal, and lumbar arteries)

Follow the sympathetic trunks along the front of the psoas muscle (on the right it is behind the IVC, and you will need to mobilise the right kidney and reflect it to the left). Look for the ganglia and lumbar splanchnic nerves passing to the preaortic plexuses (superior mesenteric, inferior mesenteric and hypogastric, in the bifurcation of the aorta).

Look for the lumbar vessels and nerves of the lumbar plexus on the posterior abdominal wall: subcostal, ilioinguinal/iliohypogastric, lateral cutaneous of thigh, femoral, genitofemoral, and obturator nerves.

Clean the muscles of the posterior abdominal wall (psoas, quadratus lumborum transversus abdominus, iliacus, the diaphragm), and examine the arcuate ligaments of the diaphragm.

On one the right side only remove the psoas muscle piecemeal to expose the lumbar nerve roots, lumbar plexus, and lumbar rami communicantes (on the side of the lumbar vertebral bodies joining the lumbar nerves to the sympathetic trunk)

Pelvic cavity from above, and the gluteal region

A. The pelvic peritoneum and structures crossing the pelvic brim

1. Follow the peritoneum from the anterior abdominal wall, onto the superior surface of the bladder. In the female it is reflected back on the body of the uterus at the uterovesical

pouch. In the male it passes over onto the posterior surface of the bladder where the seminal vesicles may be felt in the rectovesicle pouch.

2. Identify the rectouterine pouch in the female, and in both male and female, note how the rectouterine/vesicle pouch is limited laterally by the rectouterine or rectovesicle peritoneal folds (these overlies condensations of pelvic fascia which attach the bladder and cervix to the sacrum).
3. On the left and right sides of the rectum locate the para rectal fossae, What organs might be felt in these fossae, *per rectum*.
4. Identify the median (urachus) and medial (umbilical arteries) umbilical ligaments in the peritoneum passing from the bladder to the anterior abdominal wall. Separate the peritoneum (with these structures) from the anterior abdominal wall, and open the loose connective tissue space between the bladder and the pubic bones (retropubic space).
5. Explore the retropubic space, it is limited inferiorly by the puboprostatic and pubovesical ligaments. The anterior wall has the obturator internus muscle, the tendinous arch of levator ani, and the obturator nerve and vessels. Posterolaterally the space is limited by the Pelvic fascia covering vessels passing to the posterior surface of the bladder.
6. Moving laterally from the pubis, continue reflecting the peritoneum from the pelvic brim. Expose the ductus deferens or round ligament, the ovarian vessels, the ureters and internal iliac vessels.
7. Reflect the peritoneum from the posterior part of the pelvic brim, being careful to retain the superior hypogastric plexus and its connections: a) along the internal iliac arteries, b) up the branches of the inferior mesenteric to the descending colon, and c) with the lumbar sympathetic trunks (lumbar splanchnic nerves)
8. Identify the lumbosacral trunk and follow it into the pelvis where it is joined by the sacral nerves. Note that the superior gluteal artery passes among the roots of the sacral plexus.
9. In the gluteal region, locate the ischial spine and sacrospinous ligament, and find the pudendal nerve and internal pudendal vessels crossing into the lesser sciatic foramen.

The perineum

a) The anal region

1. Remove the skin from the region around the anus, and begin to clean the fat from the ischiorectal fossae in either side of the rectum. Identify the inferior rectal nerve and vessels crossing this space to supply the external anal sphincter and perianal skin.
2. Cut the sacrotuberous ligament on the right side only and trace the pudendal nerve and vessels into the pudendal canal on the medial side of the ischial tuberosity. Find the inferior rectal branches leaving the pudendal canal
3. Complete the removal of fat from the ischiorectal fossa, and expose and clean the surface of the levator ani muscle.
4. Identify the anorectal junction, noting the right angle bend. At this point the levator ani muscle is particularly thick (puborectalis). Clean parts of the external anal sphincter.
4. In the anterior part of the ischiorectal fossa, find the posterior edge of the urogenital diaphragm (transverse perineal muscles).
5. Use your finger to explore the anterior projections of the ischiorectal fossae superior to the urogenital diaphragm but inferior to the levator ani muscle on the left and right sides. With a finger in the retropubic space feel your other finger in the anterior part of the ischiorectal fossa. These fingers are separated by the levator ani muscle.
6. Find the posterior labial or scrotal nerves leaving the pudendal canal and passing into the urogenital part of the perineum.

b) The urogenital region

1. Return the body to the supine position and remove the labial or scrotal skin from the urogenital region. It may help to remove the skin and superficial fascia from the upper part of the thigh (but be sure to retain the fascia lata).
2. Remove the fat and connective tissue from the front of the pubic bones and the superficial perineal pouch. Try to find, and clean, the attachment of the fascia lata to the ischiopubic rami. Continue removing fat, and sometimes quite dense connective tissue, to expose the masses of erectile tissue (bulb & crura) covered by muscles (bulbospongiosus & ischiocavernosus).

In the male, the bulb contains the urethra and is continuous with the corpus spongiosum of the penis, and the crura, covered by the ischiocavernosus muscle, are continuous with the corpora cavernosa of the penis.

In the female, these relationships are the same except that the bulb is in two parts separated by the vestibule. The urethra opens between the two parts of the bulb. The two halves of the bulb and the crura unite anteriorly as in the male.

3. Identify the perineal membrane in the roof of the superficial pouch, between the crus and bulb.
4. Remove the skin from the penis and find the dorsal nerves and vessels. You can cut transversely through the penis to see the spongy erectile tissue, and the urethra and deep penile vessels inside the corpora, or you can detach the glans penis, together with the corpus spongiosum, from the corpora cavernosa. Note the tough fibrous envelope which ensheathes and unites the corpora cavernosa and the more flexible coat on the corpus spongiosum
5. In the female, it should be possible to find the dorsal nerves of the clitoris. The clitoris can be cut transversely and its cross section examined.
6. Try to trace the right dorsal nerve of the penis or clitoris backwards. You will need to detach the crus (and the perineal membrane) from the right ischiopubic ramus to follow the nerve through the lateral edge of the urogenital diaphragm.

Removal of hipbone and study of the Pelvic viscera

1. Raise the right side of the cadaver and support the body in this position with blocks.
2. Locate the position of the greater sciatic notch. Cut the body wall from the iliac crest and, using a hand saw, cut from the iliac crest through the ilium to the greater sciatic notch.
3. Return the cadaver to the supine position and cut or saw through the pubic symphysis.
4. Using a scalpel, carefully cut the crus and urogenital diaphragm from the ischiopubic ramus and ischial tuberosity. Cut as close to the bone as possible, shaving its surface with your scalpel. The obturator internus fascia, should be separated from its muscle so that the levator ani muscle will not be torn.

5. The sacrotuberous and sacrospinous ligaments should be cut at this stage.
6. The right lower limb, together with its hip bone will begin to separate from the rest of the body, and the main nerves and vessels passing to the lower limb will need to be cut (obturator, sciatic, gluteal and femoral nerves, the external iliac and gluteal branches of the internal iliac),

Examine the pelvic cavity with the hipbone removed

1. Examine how the urogenital diaphragm was cut from the ischiopubic ramus. Try to locate the pudendal nerve terminating in the dorsal nerve of the penis/clitoris, in the edge of the urogenital diaphragm.
2. Some of the obturator internus fascia should have remained on the pelvis. Find it and the levator ani muscle taking origin from the "tendinous arch". Identify parts of the retropubic and ischiorectal spaces in relation to the urogenital diaphragm and levator ani muscles.
3. Follow the branches of the internal iliac artery in approximate descending order: Iliolumbar, lateral sacral, superior gluteal, inferior gluteal, obturator, superior vesical and inferior vesical (or uterovaginal), and the internal pudendal and middle rectal usually coming lowest.
4. Confirm your assessment of the visceral arteries by tracing them to their organs. Find the obliterated umbilical artery continuing from the superior vesicle. Trace the inferior vesicle or uterine artery behind the bladder, and confirm its proximity to the prostate or cervix.
5. Find the sympathetic trunk in the abdomen and trace inferiorly into the pelvis. Identify lumbar and sacral splanchnic branches (and grey rami communicans). Identify again the hypogastric plexus, and the numerous visceral nerves running with the arteries.
6. Open the bladder by cutting its anterior wall, and identify the trigone and the openings of the ureters and the urethra. Try to pass (the handle of) a blunt probe through the urethra (in males, the probe will enter the bulb of the penis)
7. Explore the retropubic space down to the neck of the bladder, identify and cut the puboprostatic or pubovesicle ligament attaching the neck of the bladder to the pubic

- symphysis. Try to find the urethra emerging from the prostate (or neck of bladder), as this will help you see the upper surface of the UG diaphragm.
8. In a male, dissect the prostatic fascia from the surface of the prostate, neck of bladder, and seminal vesicles on the posterior aspect of the bladder. Clean and trace the vas deferens, seminal vesicles and ureters to the terminations in the bladder or prostate.
 9. The prostate can be opened by using a larger knife and the probe in the urethra to cut coronally, removing all the anterior parts of the prostate, bladder and penis from the in front of the probe. Alternatively the probe can be used as a guide to cut the prostate in a sagittal plane
 10. In a female trace the ureters to the posterior aspect of the bladder, and palpate the cervix to confirm their close relations. If you cut coronally down the probe in the urethra you may get a good view of the urethral sphincter. You could then use scissors to cut through the anterior vaginal wall and posterior wall of the urethra and bladder. This will give you a good look at the cervix and vaginal fornices.
 11. The organs can be removed *en bloc* by dividing the rectum, vagina and urethra where they pass through the pelvic floor. This would allow study of undisturbed parietal structures on the left side of the pelvic cavity. It also allows you to open the rectum and wash it out at the sink.